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I, JANENE PEISKER, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002952159 for a patent by REGAIN TECHNOLOGIES PTY LTD as filed on 18 October 2002.



WITNESS my hand this
Seventh day of November 2003

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TEAM LEADER EXAMINATION
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PROVISIONAL SPECIFICATION

Applicant(s):

REGAIN TECHNOLOGIES PTY LTD
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Invention Title:

TREATMENT OF SMELTING BY-PRODUCTS

The invention is described in the following statement:

TREATMENT OF SMELTING BY-PRODUCTS

This invention relates to a method and apparatus of treating smelting by-products and in particular by-products of the aluminium smelting process.

Production of aluminium metal typically involves the electrolytic reduction of alumina in cells or pots. The electrolyte is made up of molten cryolite and other additives. The electrolyte is contained in a carbon and refractory lining in a steel potshell. Over time the effectiveness of the lining deteriorates and the lining of the pot is removed and then replaced with a new lining. The lining material that has been removed from the pot is referred to a spent potliner (SPL).

SPL is hazardous because of -

- Health and environmental hazards due to the presence of cyanide formed as a result of the reaction of nitrogen from air with the carbon lining.
- Reactive components that combine with water to give of ammonia, methane and hydrogen which presents a potential explosion hazard.

Disposal of SPL has been a problem for many years. In the past it was used as landfill but is now viewed as not environmentally friendly and thus its use as landfill has been banned in many countries. Consequently there have been many proposals to treat and handle SPL. Most of these proposals create some residual waste which can be used as landfill.

This invention comes about from the appreciation that SPL is potentially valuable because of the calorific value of the carbon that it contains and the presence of minerals such as alumina, fluorides, silica and sodium that can be used in other industries.

It is these issues that have brought about the present invention.

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SUMMARY OF INVENTION

In accordance with a first aspect of the present invention there is provided a method of treating a spent potliner after use in an aluminium smelting process, the
10 method comprising crushing and classifying the spent potliner, placing the classified and crushed spent potliner in a furnace at a temperature greater than 450°C, mixing the hot spent potliner with water to produce reaction gases, burning the reaction gases, mixing the
15 residue with water and exposing the wet mixture to air for a period of weeks to cure the residue, and blending the cured residue with other chemicals and minerals to provide mineral products of desired characteristics.

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Preferably the classified spent potliner is positioned in a rotary kiln into which air is introduced to ensure an oxygen enriched environment.

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Preferably thermocouples are used to control the temperature of the kiln. In a preferred embodiment control jets of air are directed into the kiln to prevent agglomeration.

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In accordance with a further aspect of the present invention there is provided a plant for processing spend potliners after use in the aluminium smelting process using the method described above.

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DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram that illustrates the flow chart to treat spent potliner,

Figure 2 is a detailed flow chart of a detoxification process that forms part of the process illustrated in Figure 1, and

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Figure 3 is a schematic view of the process plant.

DESCRIPTION OF THE PREFERRED EMBODIMENT

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In essence the process for treating the spent potliner (SPL) of an aluminium smelter is shown in Figure 1 in three main steps, namely,

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(1) feed preparation in which the spent potliner is prepared crushed and classified,

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(2) detoxification in which the material is mixed with air and water to destroy the presence of cyanide and cause neutralisation of reactive materials with the air and water and

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(3) a blending step in which treated SPL is mixed with other materials to produce mineral products of particular specifications which can be reused.

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The feed preparation step involves recovery of the SPL material either from a storage depot or directly from the smelter pots, primary segregation of aluminium metal, carbon material and refractory materials and crushing size classification and secondary segregation of the materials into like categories.

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Initially classified SPL is fed to the process plant. The sizing of the feed material can vary but typically falls in the range 50 microns to 20mm.

The detoxification step involves a destruction of most of the cyanide through heat and then neutralisation of the reactive compounds using water and air. The blending step producing mineral products takes place by
5 blending the detoxified materials with other minerals and chemicals to achieve the desired product specification.

The detoxification process that is shown in detail in Figure 2 eliminates or substantially reduces the
10 health environmental and explosive hazards that would otherwise be present in SPL. The process involves a destruction of cyanide and the neutralisation of reactive compounds that give off acetylene, ammonia, methane, hydrogen and other gases. In the process described below
15 it is understood that many of the requirements such as the heating temperatures and retention times would vary with different types of SPL material.

The potentially dangerous cyanide is destroyed by
20 heating the SPL material in the presence of oxygen preferably to a range of between 750°C to 800°C. The heated SPL is held at that temperature for about 40 minutes. It is however important that the classified SPL is not over heated to a temperature at which fluorides in
25 the material enter the gaseous phase. This typically occurs at temperatures about 850°C and above. The classified SPL is heated to the required temperature in a rotary kiln and the retention time in the material can be varied by varying the rotational speed of the kiln. The
30 kiln is usually fired by a fossil fuel burner and fuels could be natural petroleum gas, oil, pulverised coal or similar fuels. Additional air is introduced to the kiln to ensure that there is an oxygen rich environment in the kiln to support the chemical breakdown of cyanide. The
35 temperature in the kiln is closely monitored with a number of thermocouple temperature probes located in the bed of material passing through the kiln. The temperature probes

are mounted on a stainless steel tube through which air is blown from a compressed air source. Blowing air through the tube serves three purposes, namely

5 (a) keeping the tube cool so that its structural integrity is maintained in the hot kiln environment,

(b) keeping the signal cables from the thermocouple temperature probes cool in the otherwise hot environment in the kiln, and

10 (c) introducing oxygen near the bed at points along the length of the kiln.

Some classified SPL materials have a tendency to agglomerate in the rotary kiln. This can occur at the feed end when slightly damp material may build up and at
15 points along the kiln where rings form as a result of heat causing certain minerals to enter a liquid phase. Agglomeration is prevented with agglomeration control jets which direct air from a compressed air source to points where agglomeration may occur. At the feed end the jet of
20 compressed air blows any material that sticks to the kiln lining off the kiln lining.

At points along the kiln where mineral in a liquid phase sticks to the kiln lining starting the
25 formation of undesirable rings compressed air from an agglomeration control jet cools any liquid material returning it to a solid phase. The air jet also cools the refractory lining at that location stopping the formation of liquid material against the hot refractory.
30 Agglomeration control jets provide additional free oxygen in the kiln to support the breakdown of cyanide.

The agglomeration control jets are mounted on a stainless steel pipe inside the kiln. The compressed air
35 flowing through the pipe cools the pipe thus maintaining its structural integrity in the same manner as for the tube upon which the kiln temperature probes are mounted.

The reactive compounds that come out of the kiln are neutralised in two stages. In the first stage, known as the hydro-reaction stage, the hot 300°C to 500°C SPL material is mixed with water 5°C to 20°C by dropping the material into a screw mixer and spraying the material with water. The water reacts with the aluminium metal, sodium metal and reactive compounds giving off steam and gases such as acetylene, ammonia, hydrogen and methane. These reaction gases are passed through a flame to ensure that flammable gases are destroyed and to use the calorific value of those gases to assist in heating the classified SPL. Most of the reactive gases are given off in this first stage. Samples of the product from this stage are tested for cyanide and reactive compounds.

The second stage of neutralisation is ventilated curing and occurs over a period of up to four weeks. Ventilated curing involves mixing the product from the first neutralisation stage of ambient temperature with water 5°C to 20°C and exposing the wet material to air. A stockpile of material is mixed with water in a well ventilated area using a front end loader. The stockpile is then left to cure in the well ventilated area. During this time a small amount of reactive gases are given off. The loader mixing process typically involves ten minutes of loader mixing for a 50 tonne stockpile of material. The mixing loader mixing takes place on a daily cycle for five to six days of each calendar week. Progressive samples are taken and tested for reactive compounds.

Environmental control of the plant is achieved by passing the process gas through a baghouse dust filter. The hot gases from the heating and hydro-reaction processes are mixed with atmospheric air to cool the process gas to the range of between 100 to 120°C. The cooled gas is then passed through a baghouse filter to

remove mineral dust from the exhaust gas. The mineral dust is returned to the process plant.

- 5 Dated this 18th day of October 2002
REGAIN TECHNOLOGIES PTY LTD
By their Patent Attorneys
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10 Trade Mark Attorneys of Australia

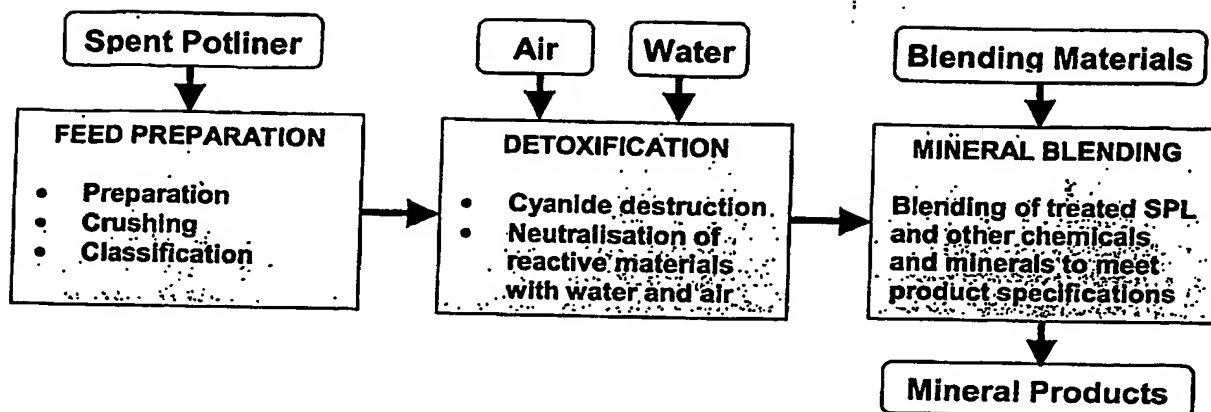


Figure 1 – SPL to Mineral Product Process

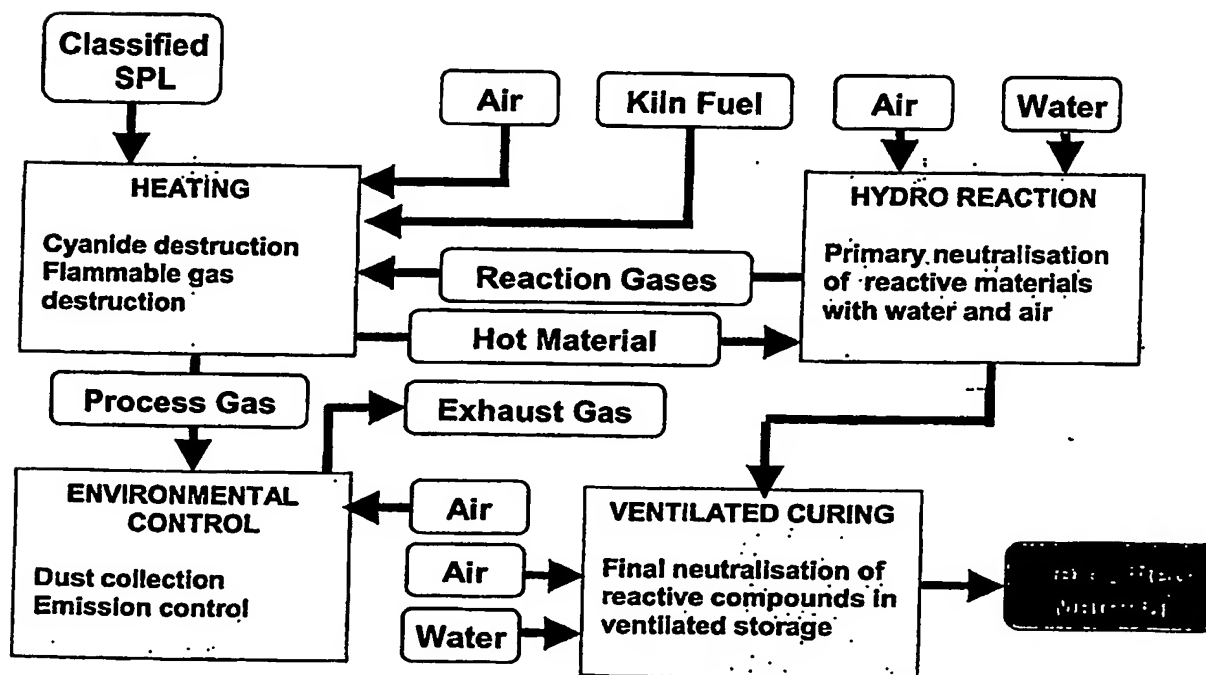


Figure 2 – Detoxification Process Flow Summary

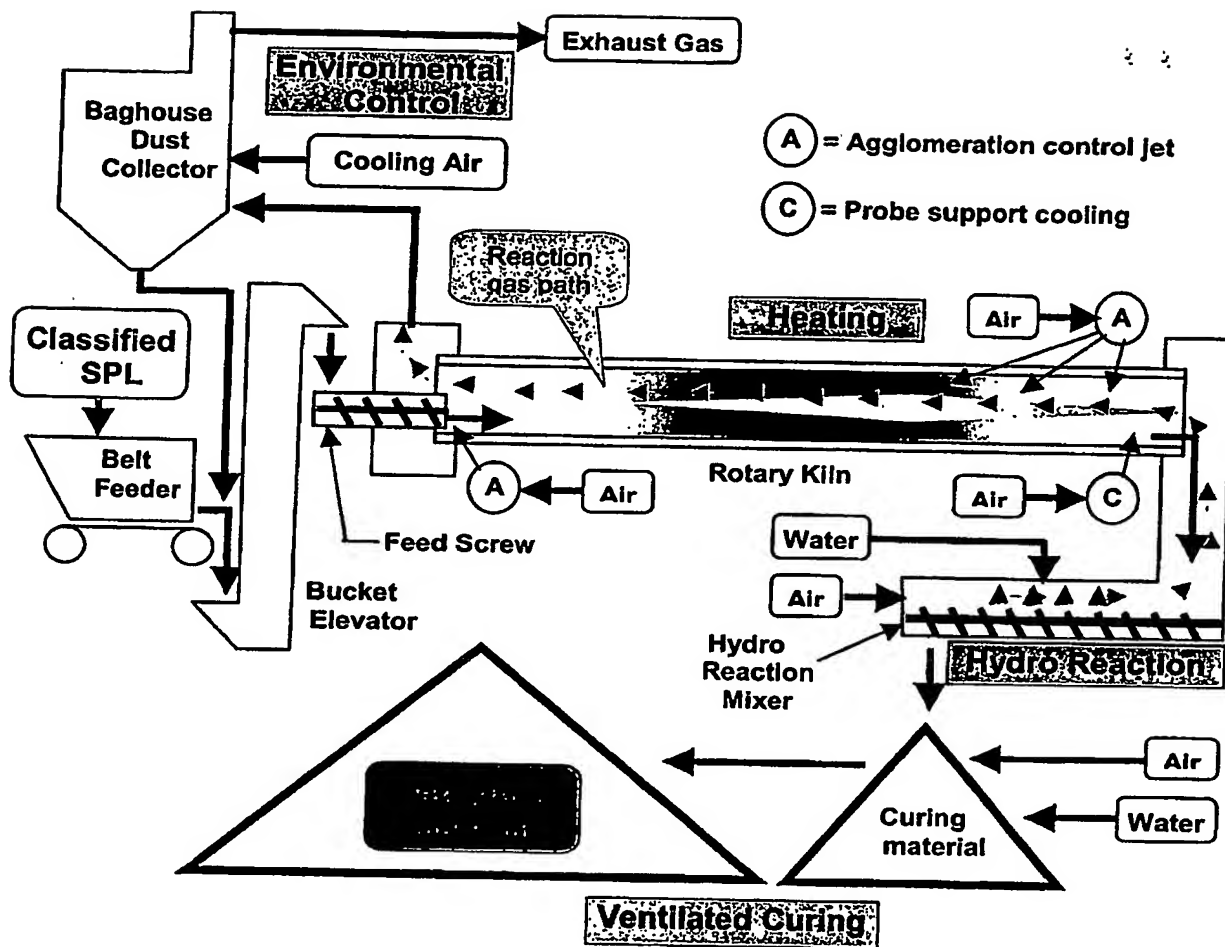


Figure 3 – Process Plant Schematic

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